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Planting and Grafting Resistant Vines.

In view of the growing interest in the important matter of rendering our vineyards proof against the attacks of the phylloxera, and of the delay in the publication of the report for 1886, in consequence of the accumulation of matter at the State printing office, an abstract of the main points discussed somewhat elaborately in the forthcoming report, is here given, in order that those contemplating the use of resistant stocks for this season may be assisted in their choice of varieties.

The true criterion of resistants is that the vine and its roots will not only outlive the attacks, but flourish and bear remunerative crops, under the same conditions under which the more sensitive European vines will succumb.

But every vine, like every other plant, is subject to certain conditions of soil, climate, and atmosphere for its welfare. Any vine, or any other plant, may be planted where from unfavorable conditions it will not flourish, and where a slight addition to the adverse influences may cause it to either die or maintain only a feeble existence, useless to the cultivator for profit. The resistant vines are no exception to this general rule.

Adaptation of Vines to Soils.—It is not reasonable to suppose that a vine which is naturally at home in rich, heavy lowland soils, should not only flourish but supply extra strength against attack from without, in thin, meager uplands, or on land exhausted by long cultivation; nor that a vine whose hardy roots resist the phylloxera when growing in its natural location on dry, rocky uplands, will necessarily retain this character when grown in rich, moist lowland. To a certain extent, cultivation does modify and equalize the natural soil-conditions, especially when it is thorough and is faithfully kept up. But there always remains a certain margin of natural adaptation which must be respected even in the cultivated plant, and the more because climatic and seasonal conditions may render a strict fulfillment of the best culture impracticable, or unavailing for the time being. Those cultivating adobe soils will appreciate the importance which this consideration may acquire, not only for one but for several consecutive seasons.

Species and Varieties of Resistants.—Of the American species and varieties that, for practical purposes, may be considered as resistant under proper conditions of soil and moisture, the following are the most prominent:

1. The *Vitis riparia*, or northern riverside grape and its cultivated varieties, of which the Taylor and Clinton are the chief. The resistant power of the latter is now, however, pretty generally admitted to be inferior to that of their wild prototype, although they are better adapted to a great variety of soils. The

Riparia is in its wild state emphatically a "riverside" grape, which in its natural condition ascends into the uplands only exceptionally, when these are unusually moist and fertile. Under cultivation, nevertheless, it does well in good upland, but is of slower growth than in its natural *habitat*. It does not frequent the heavier soils as much as the alluvial loams of the upper Mississippi valley. It is of very long-jointed, slender growth, so that its canes, while of great length and bearing abundance of foliage, are often borne by a surprisingly thin trunk, which is not as easy to graft as most other varieties. The cuttings root with great ease, but generally only a portion, varying according to the soil and seasons from one-half to three-fourths, are large enough to be successfully grafted the third year; seedlings arrive at about the same condition the fourth year from the seed. To offset these disadvantages, the *Riparia* is now usually considered the most generally and tenaciously resistant toward the attacks of the phylloxera. It is very little liable to mildew.

2. *Vitis cordifolia*, the southern riverside grape, so greatly resembles the *Riparia* that for some time it was not distinguished as a separate species. While it is undoubtedly a very resistant stock, the fact that it is at home in a region noted for its perpetually moist atmosphere, seems to render it less promising for general success in California than the *Riparia*, over which, so far as known, it possesses no special advantages, save, perhaps, in the case of very heavy adobe soils, to which it is better adapted than the *Riparia*.

3. The *Vitis aestivalis* or summer grape is a native of the uplands of the States east of the Mississippi, and is at home on loam soils of good or fair fertility. It also descends into the lowlands of the smaller streams, so that it and the *Riparia* vine are not uncommonly seen side by side. But it is rarely if ever found in the larger bottoms, though quite at home in the lighter and usually well drained "second bottoms" or "hammocks." Unlike the riverside grapes, it objects to "wet feet." It is little subject to mildew. Of the cultivated varieties of the *aestivalis* grape, those of chief interest as resistants are Norton's Virginia, Herbeumont, and the well-known Lenoir. The cuttings of these, as well as the wild vine, root with some difficulty; they should be rooted in nursery, and not in the vineyard itself.

4. *Vitis rupestris*, the sugar or rock grape of Missouri, is a very hardy vine, at home on rocky knolls and hillsides, where its wiry roots extract nourishment from the scanty soil and the crevices of rocks, in a climate already partaking somewhat of the aridity of the great plains. It would, therefore, seem to be of con-

siderable promise for the foothills of California especially; of its resistance to the phylloxera there can be no question. It is, however, not easy to root from cuttings, being in this respect like the *aestivalis* varieties. In my personal experience I have found it to be of slow growth on rich upland adobe, even more so than the *Riparia*, so that very few cuttings were ready for the graft the third year; moreover, even when the top of the stock is sufficiently stout for grafting, that portion generally tapers off very rapidly downward, so as to afford very little "grip" for the graft, which has to be tied in very thoroughly. The successful grafts, however, have shown a vigorous growth and seem well joined. The multitude of wiry suckers which the stock persists in putting forth to the end of the season constitutes an inconvenience, shared to some extent by the *Riparia*, and least of all by the *Californica*, which soon gives up sprouting its easily detached suckers. The *Rupestris* is least subject to mildew of all the resistant stocks.

5. *Vitis Californica*, the California wild grape (not, as some still imagine, the "Mission" vine, which is very sensitive toward the phylloxera), has been prominently brought forward as a resistant stock for use in its native State, to the climate of which it must be presumed to be especially adapted. This reasonable presumption gives it so great a claim to attention and renders its pre-eminent success so probable, that nothing but the strongest proof of its non-resistance should induce us to relinquish its use; but experience speaks strongly in its favor. It goes without saying that the *Californica*, like any other vine, may be planted in the wrong place, where its half-starved roots become hardened, and instead of yielding so as to render deformation from the bite of the phylloxera impossible, will curve and curl, and finally die and decay.

The *Californica* is very liable to mildew, and it is probably from this cause that it is but rarely found on the coastward slope of the Coast ranges, which are much exposed to the sea fogs. There is, however, no difficulty in protecting it by repeated sulphuring, up to the time of grafting.

6. *Vitis Arizonica*, the wild grapevine of Arizona and Sonora, resembles somewhat the *Californica* in its general appearance and habits of growth. In rapidity of growth it seems to be nearly or quite equal to the *Californica*, and quite its equal in resistance to the phylloxera, as well as to drought. It is subject to mildew nearly as much as the former. Its roots, also, seek the depths of the soil before branching, and the stock is stout and easily grafted. From experience had at the University, it deserves more attention than has heretofore been bestowed upon it.

In none of the stocks mentioned above does there appear to be any intrinsic difficulty about making a sound joint with the *vinifera* varieties. But when a strong grower is grafted upon a weak one, there may be difficulty on account of the weak base of a stouter trunk. In the reverse case there is no trouble, for a relatively stout base for a weak trunk is desirable. The strong-growing *Californica* will, in

its own home, furnish just such a stock for all, or almost all, the *vinifera* varieties, which it exceeds in growth whenever planted in appropriate soils.

In my personal experience with the *Californica*, I have found only one variety which seems to exceed it a little in growth when grafted, viz.: the *Clairette Blanche*, which is an extraordinary grower. In the case of five other varieties grafted in my vineyard (Black Burgundy, Palomino, Mondeuse, Verdelho, Cinsaut) the graft junction is at the end of the season either straight (*i. e.*, a cylinder), or like a wine bottle right side up, the *Californica* stock forming the body of the bottle, the graft the neck. There can be no doubt that in these cases the stock will push the growth of the grafted variety.

Where the same varieties have been grafted on the *Riparia* or *Rupestris* stock, the case is just the reverse. Here the graft junction resembles a bottle placed neck down, and it is at least questionable that the stock will be able to supply fully the needs of the graft, and pretty certain that it will not tend to push the latter beyond what its growth would be if on its own root. In the case of the *Rupestris* and *Clairette* the disproportion is painful to contemplate, the quill-like stock appearing absurdly inadequate to the support of the graft that has swelled to the proportion of a man's thumb. That this is felt by the stock is apparent from the frequency with which the grafts have thrown out their own roots when on either *Rupestris* or *Riparia* stock, thus defeating the primary object of grafting at all. No such tendency is seen in the same varieties where they are on the *Californica* stock. But this, it must be remembered, happens on a soil peculiarly well adapted to the *Californica*, and on which the *rupestris*, at least, should not have been used at all.

Experience which appears in some respects the reverse of my own, has been had by the Briggs Bros. near Winters, in a light alluvial soil.

As has been shown in a former bulletin (No. 24) the *Californica* appears in the uplands preferably on heavy, rich soils, although in the valleys it does well on a great variety of lands. In the red gravelly uplands of the Coast Range and foothills, it should probably be replaced by some of the *Aestivalis* stocks, such as Lenoir or Herbemont.

Rapidity of Development of the Several Resistant Vines.—That in our climate the *Californica* develops most rapidly of all, especially as to making a stock of grafting size, is hardly doubtful. The experiments made at the University from 1881 to the present time, as well as personal experience in my vineyard at Mission San Jose, fully corroborate the claim that the *Californica* is a stock of extraordinary vigor on favorable soils, and will bear very early grafting. It will be remembered that in the first experiments made with the grafting of seedlings at the University, in 1881, of seedlings one year old about 40 per cent were found stout enough for grafting, and were successfully grafted; a thing not even remotely possible with any other species of vine yet tested, and least of all perhaps with the *riparia*, whose

seedlings are of exceedingly slow development. Thus, of a plantation of *riparia* seedlings located on exceedingly favorable soil on Mr. John T. Doyle's place at Cupertino, not one could have been grafted when two years old, and only a few were fairly graftable when four years old.

At my own vineyard at Mission San Jose, the stocks from one-year-old *Californica* seedlings planted in spring of 1884 were, without exception, large enough to be grafted in spring 1885, despite a very unfavorable season. They were not actually grafted, however, until March and April, 1886, when, notwithstanding the extraordinarily dry season preceding, the trunks ranged in thickness from a minimum of two-thirds of an inch to fully $1\frac{1}{4}$ inch, and sometimes more; so that two grafts could readily have been inserted in a large portion of them. Of the *Riparia* cuttings planted at the same time as the *Californica* seedlings, few exceeded one-half inch in thickness, and very many were too slender to be grafted with any prospect of success, especially in view of their large pith. Of the *Rupestris* cuttings planted at the same time, few reached the thickness of half an inch, and many appeared no thicker than when planted, three years before, except that they had at the top a short head, like that of an old short-pruned stock, but too short to be of any use in making the graft.

In this case, however, all the conditions were most favorable to the *Californica* stock, as observed on the wild vine on its own ground.

As to loss or gain of time in grafting, a loss of 10 per cent of the grafts made in the field must ordinarily, I think, be considered a very favorable result; it will more frequently amount to between 12 and 20 per cent, varying not only according to the skill of the grafters, but very largely depending upon the condition of the grafts used, and upon the weather following the operation; also, to a not inconsiderable degree, upon the nature of the soil. The influence of the latter becomes apparent from the fact that vine-grafting must be done either several inches below the surface of the ground, or, if done at or near the surface, the soil must afterward be piled up around the graft for protection against drying-out. In the case of an

adobe soil, in which the water may remain near the surface for several days after a rain, the intrusion of muddy water into the cleft or cut, and a consequent weakness of the junction and even risk of failure to unite, may take place. Hence, as such soils in good tilth retain moisture very strongly, I incline to think that in them the grafting is best done within one or two inches of the surface, the piling-up of the earth around the graft being relied on to prevent drying. With the same view, my personal experience inclines me to favor late* rather than very early grafting, because then the free flow of sap from the stock keeps the graft in good heart.

I think the average experience will be found to be that there is a loss of one year, or thereabouts, when a vineyard is grafted instead of being allowed to bear directly from the cuttings; and that on the large scale the cases or gain in time will be very exceptional.

Propagation of the Resistant Stocks.—Of the above species the *riparia* is the one of which the cuttings can unhesitatingly be planted directly in the vineyard; the *Arizonica* is next; while the rest, including the *Rupestris*, should preferably be rooted in nursery. Probably it would also be best to graft them there.

From what I have seen of the growth and habits of *riparia* seedlings, I should not incline to their use in preference to cuttings, on account of their delicacy and extremely slow development. It is quite otherwise with the *Californica*, of which even very small seedlings grow very readily and rapidly, and are very tenacious of life under very adverse circumstances.

Considering the advantages to be gained by grafting on vigorous resistant stocks in regions menaced by the possible importation of the phylloxera, one season's delay (which I think should be looked for by those who graft) should not deter any one from taking this needful, and with proper care as to adaptation, ultimately profitable precaution. E. W. HILGARD.

Berkeley, Jan. 28, 1887.

* "Late" as regards the stage of development of the leaves, but not necessarily late in the season.